Fig. 1

"FatherInfo" Content File

```
<?xml version="1.0" standalone="yes">
<!-- file name :    FatherInfo.xml-->
<FatherInfo   DateUpdated= "February 1, 2000"  >
        <Name>
        Yoichiro Sato
        </Name>
        <Work>
                <CompanyName>
                ABC Paper Mill
                </CompanyName>
                <CompanyAddress>
                3-5 Uchisaiwai-cho, Niigata
                </CompanyAddress>
                <CompanyTelephone>
                025 432 3221
                </ CompanyTelephone>
                <FatherContactAtWork   Cname= "C1"  >
                        <DirectPhone>
                        025 432 3229
                        </DirectPhone>
                        <Secretary>
                                <SecretaryName>
                                Ken Morita
                                </SecretaryName>
                                <SecretaryPhone>
                                025 432 3231
                                </ SecretaryPhone>
                        </Secretary>
                </FatherContactAtWork>
        </Work>
        <AnnualSalary    Cname= "C2"  >
        10,000,000
        </AnnualSalary>
</FatherInfo>
```

Fig. 2

"MotherInfo" Content File

```
<?xml version="1.0" standalone="yes">
<!-- file name :    MotherInfo.xml-->
<MotherInfo>
        <Name>
        Keiko Sato
        </Name>
        <Work>
                <CompanyName>
                IROHA Bakery
                </CompanyName>
                <CompanyAddress>
                12-8 Terao-cho Niigata
                </CompanyName>
                <CompanyTelephone>
                025 876 1453
                </ CompanyTelephone>
                <MotherContactAtWork   Cname= "H1" >
                        <DirectPhone>
                        025 876 1458
                        </DirectPhone>
                        <EmergencyNumber>
                        025 876 1450
                        </ EmergencyNumber>
                </ MotherContactAtWork>
        </Work>
        <AnnualSalary   Cname= "H2" >
        8,000,000
        </ AnnualSalary>
</MotherInfo>
```

Fig. 3

"SatoBookkeeping" Content File

```
<?xml version="1.0" standalone="yes">
<!--  filename :  SatoBookkeeping.xml  -->
<SatoBookkeeping>
    <AnnualIncome  Cname= "Z" >
    </AnnualIncome>
    <AnnualExpense>
        <Food>
        </Food>
        <HousingLoan>
        </HousingLoan>
        <Miscellaneous>
        </Miscellaneous>
    </AnnualExpense>
</SatoBookkeeping>
```

Fig. 4

"SatoTelephoneDirecory" Content File

```
<?xml version="1.0" standalone="yes">
<!-- file name :    SatoTelephoneDirectory.xml    -->
<SatoTelephoneDirectory>
            <Home>
            025 634 9120
            </Home>
            <Work   Cname= "W"  >
            </Work>
</ SatoTelephoneDirectory>
```

Fig. 5

"SatoBookkeeping" Content File

After execution of the dependency clause[Z, (C2, H2), C2+H2]:

```
<?xml version="1.0" standalone="yes">
<!-- filename : SatoBookkeeping.xml -->
<SatoBookkeeping>
    <AnnualIncome Cname= "Z" >
      18,000,000
    </AnnualIncome>
    <AnnualExpense>
        <Food>
        </Food>
        <HousingLoan>
        </ HousingLoan>
        <Miscellaneous>
        </Miscellaneous>
    </AnnualExpense>
</ SatoBookkeeping>
```

Fig. 6

"SatoBookkeeping" Constraint File

```
<?xml version="1.0" standalone="no" ?>
<!DOCTYPE Constraints SYSTEM "http://www.iuj.ac.jp/xml/Constraints.dtd">
<Constraints>
        <Target docURL="http://www.iuj.ac.jp/xml/SatoBookkeeping.xml">
        SatoBookkeeping
        </Target>
        <Reference docURL="http://www.iuj.ac.jp/xml/FatherInfo.xml">
        FatherInfo
        </Reference>
        <Reference docURL="http://www.iuj.ac.jp/xml/MotherInfo.xml">
        MotherInfo
        </Reference>
        <Definition>
                <Cvariable >    Z   </Cvariable>
                <math>
                        <apply>
                                <plus/>
                                <ci> C2 </ci>
                                <ci> H2 </ci>
                        </apply>
                </math>
        </Definition>
</Constraints>
```

Fig. 7

"SatoTelephoneDirecory" Content File
After execution of the dependency clause [W, (C1, H1), buildTree(C1, H1)]

```
<?xml version="1.0" standalone="yes">
<!-- file name :   SatoTelephoneDirectory.xml   -->
<SatoTelephoneDirectory>
        <Home>
        025 634 9120
        </Home>
        <Work  Cname= "W" >
            <FatherContactAtWork  Cname= "C1" >
                <DirectPhone>
                025 432 3229
                </DirectPhone>
                <Secretary>
                    <SecretaryName>
                    Ken Morita
                    </SecretaryName>
                    <SecretaryPhone>
                    025 432 3231
                    </ SecretaryPhone>
                </Secretary>
            </FatherContactAtWork>

            <MotherContactAtWork  Cname= "H1" >
                <DirectPhone>
                025 876 1458
                </DirectPhone>
                <EmergencyPhone>
                025 876 1450
                </ EmergencyPhone>
            </ MotherContactAtWork>
        </Work>
</ SatoTelephoneDirectory>
```

Fig. 8

"SatoTelephoneDirecory" Constraint File

```
<?xml version="1.0" standalone="no" ?>
<!DOCTYPE Constraints SYSTEM "http://www.iuj.ac.jp/xml/Constraints.dtd">
<Constraints>
        <Target docURL="http://www.iuj.ac.jp/xml/ SatoTelephoneDirectory.xml">
        SatoTelephoneDirectory
        </Target>
        <Reference docURL="http://www.iuj.ac.jp/xml/FatherInfo.xml">
        FatherInfo
        </Reference>
        <Reference docURL="http://www.iuj.ac.jp/xml/MotherInfo.xml">
        MotherInfo
        </Reference>
        <Definition>
                <Cvariable >    W   </Cvariable>
                <math>
                        <apply>
                                <buildTree/>
                                <ci> C1 </ci>
                                <ci> H1 </ci>
                        </apply>
                </math>
        </Definition>
</Constraints>
```

Fig. 9

Content Nets: an Example

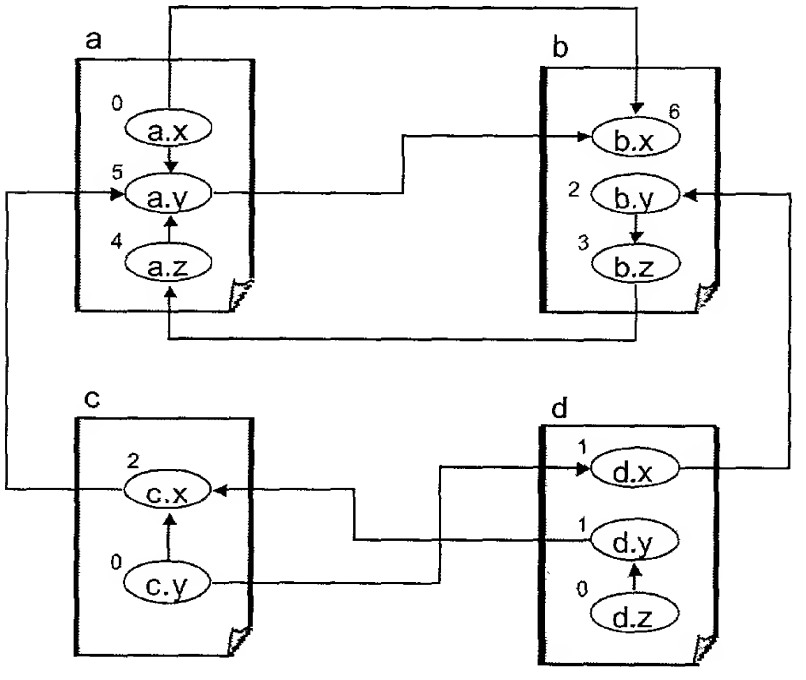
- The set of content files : {a, b, c, d}
- Constraint File in which dependency relationships are separated from contents.

$a.y = F_1(a.x, a.z, c.x)$
$a.z = F_2(b.z)$

$b.x = F_3(a.x, a.y)$
$b.y = F_4(d.x)$
$b.z = F_5(b.y)$

$c.x = F_6(c.y, d.y)$

$d.x = F_7(c.y, c.y)$
$d.y = F_8(d.z)$



Notes:

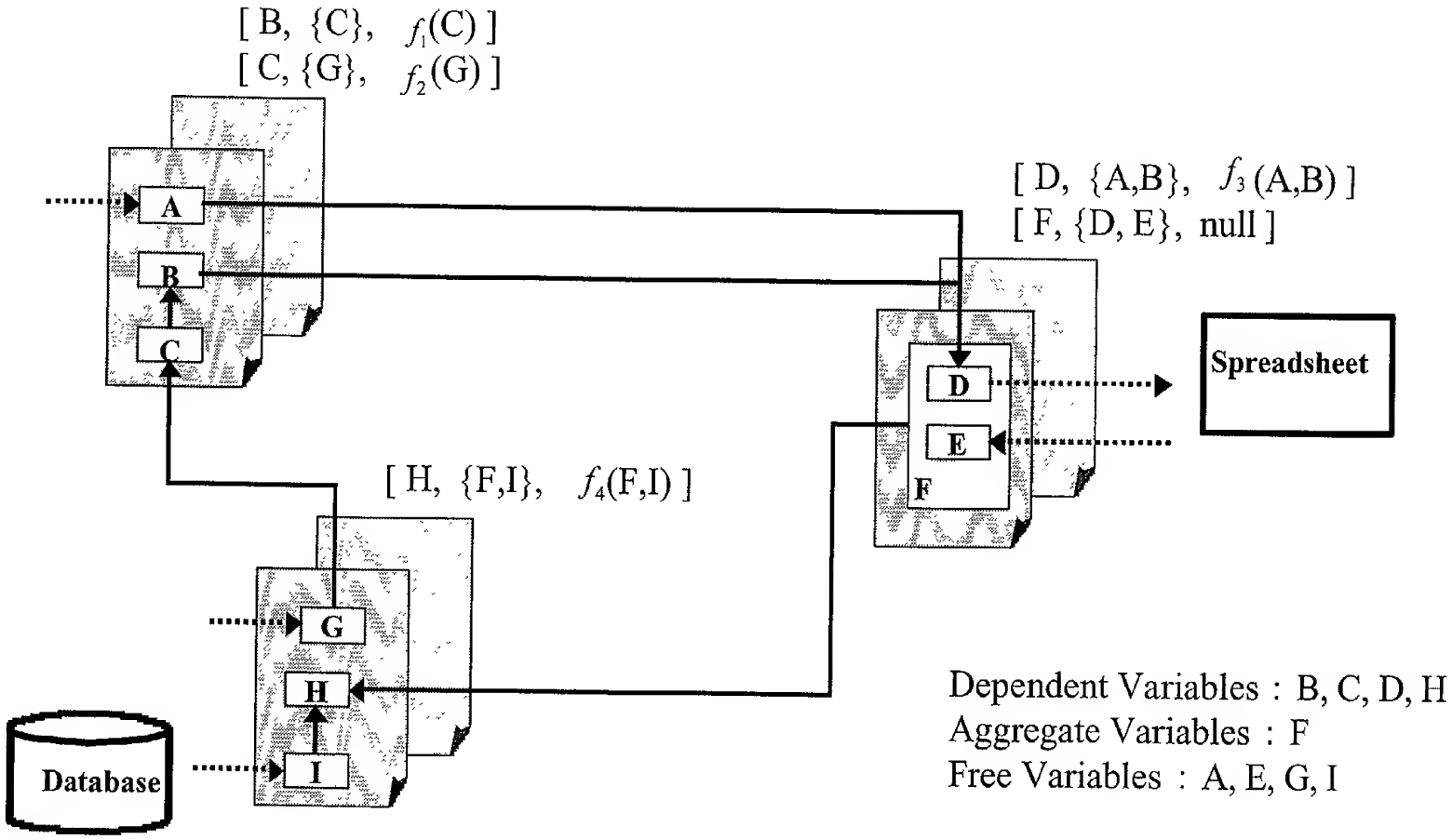
: Web documents

: Active elements

a.x, a.y, ... d.y, d.z : Element identifiers

a.x, c.y, d.z : Initial elements

Fig. 10



Dependent Variables : B, C, D, H
Aggregate Variables : F
Free Variables : A, E, G, I

: Dependency Relationships among Elements

: Information Flow in or out of the Content Net

: Content Files

: Elements in Content Files

: Constraint Files

Fig. 11

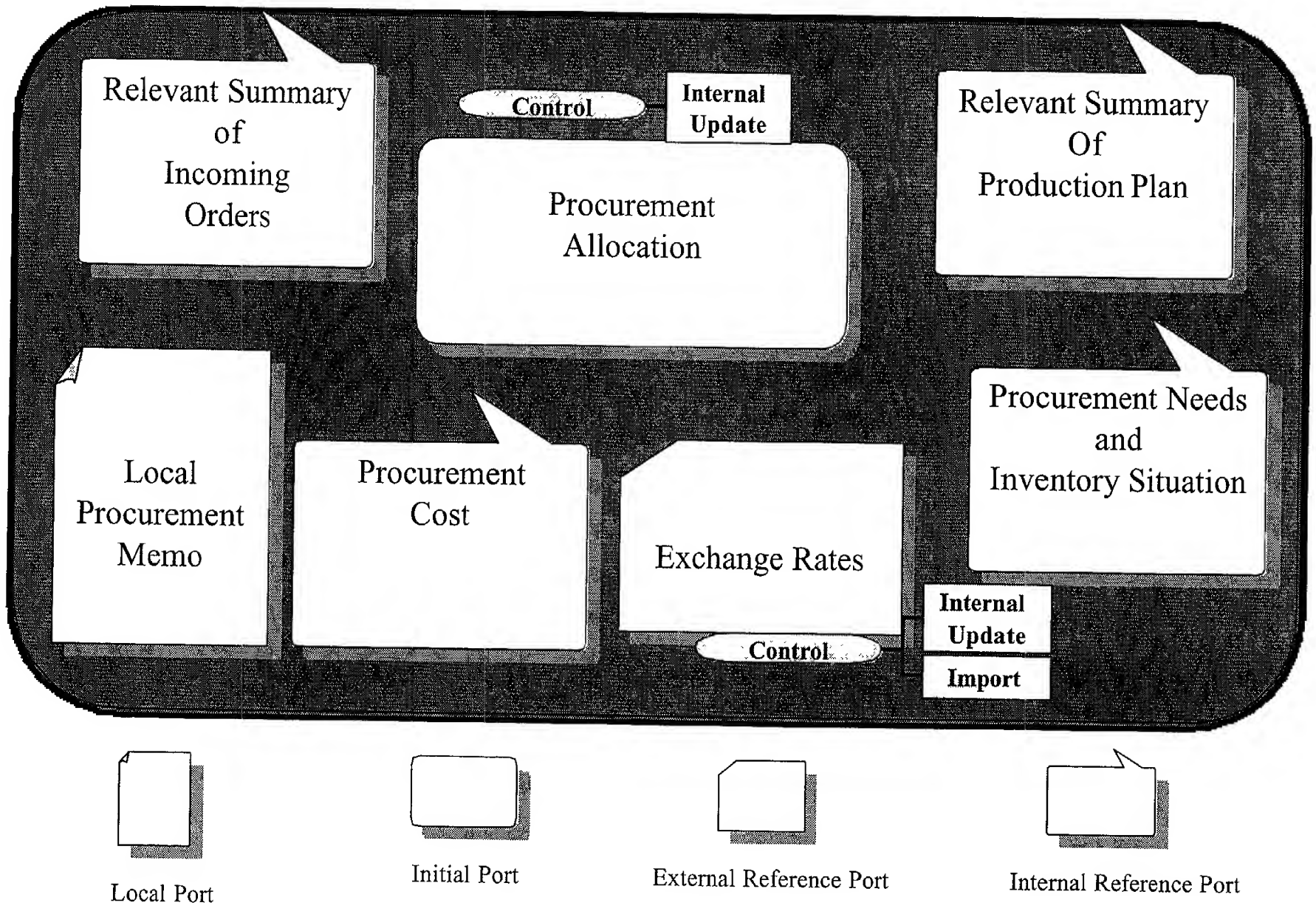
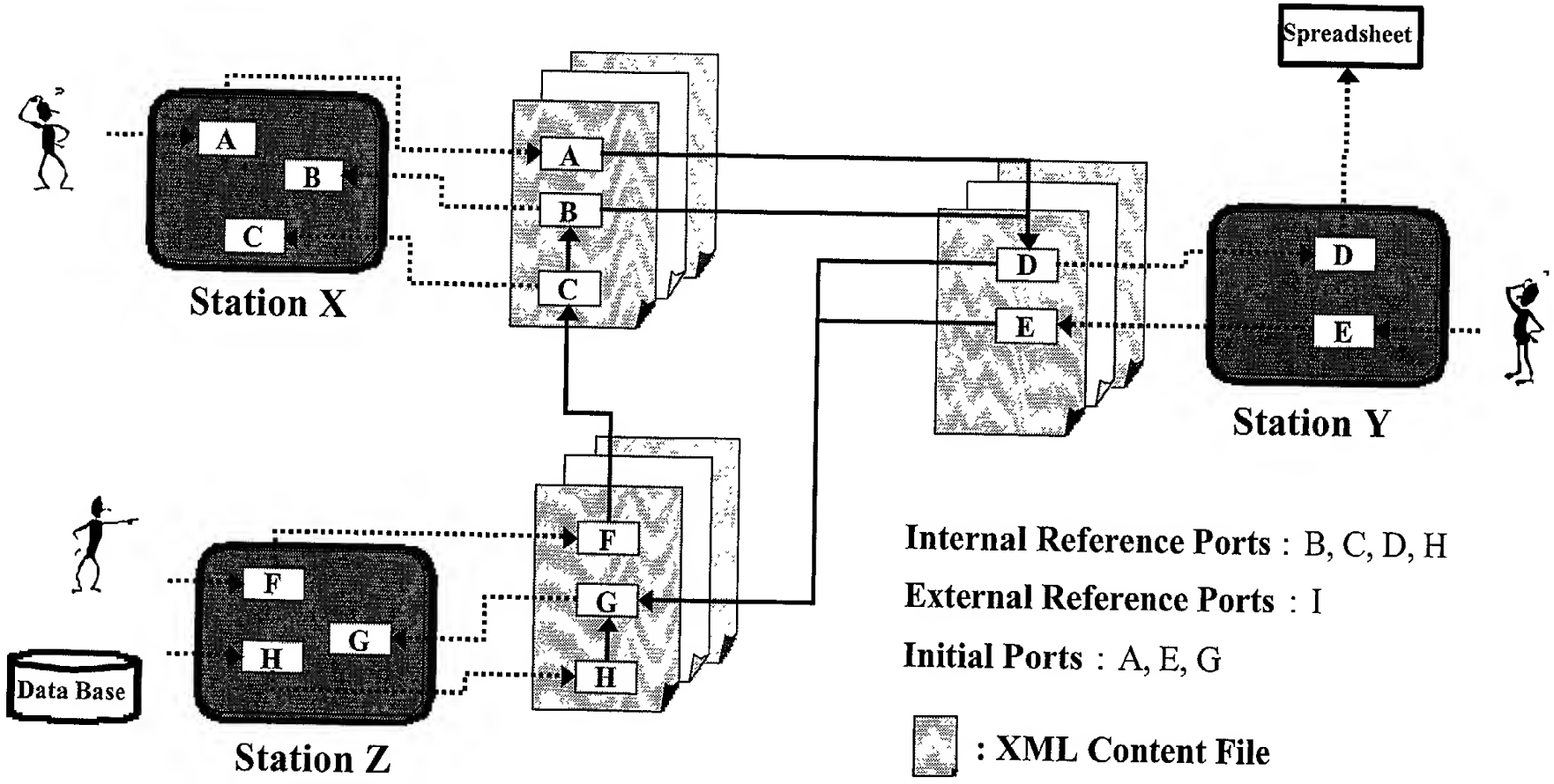

Relevant Summary of Incoming Orders
Control
Internal Update
Procurement Allocation
Relevant Summary Of Production Plan
Local Procurement Memo
Procurement Cost
Exchange Rates
Procurement Needs and Inventory Situation
Internal Update
Import
Control
Local Port
Initial Port
External Reference Port
Internal Reference Port

Fig. 12



Internal Reference Ports : B, C, D, H

External Reference Ports : I

Initial Ports : A, E, G

: XML Content File

: Element in XML Content File

: XSL Style Sheet

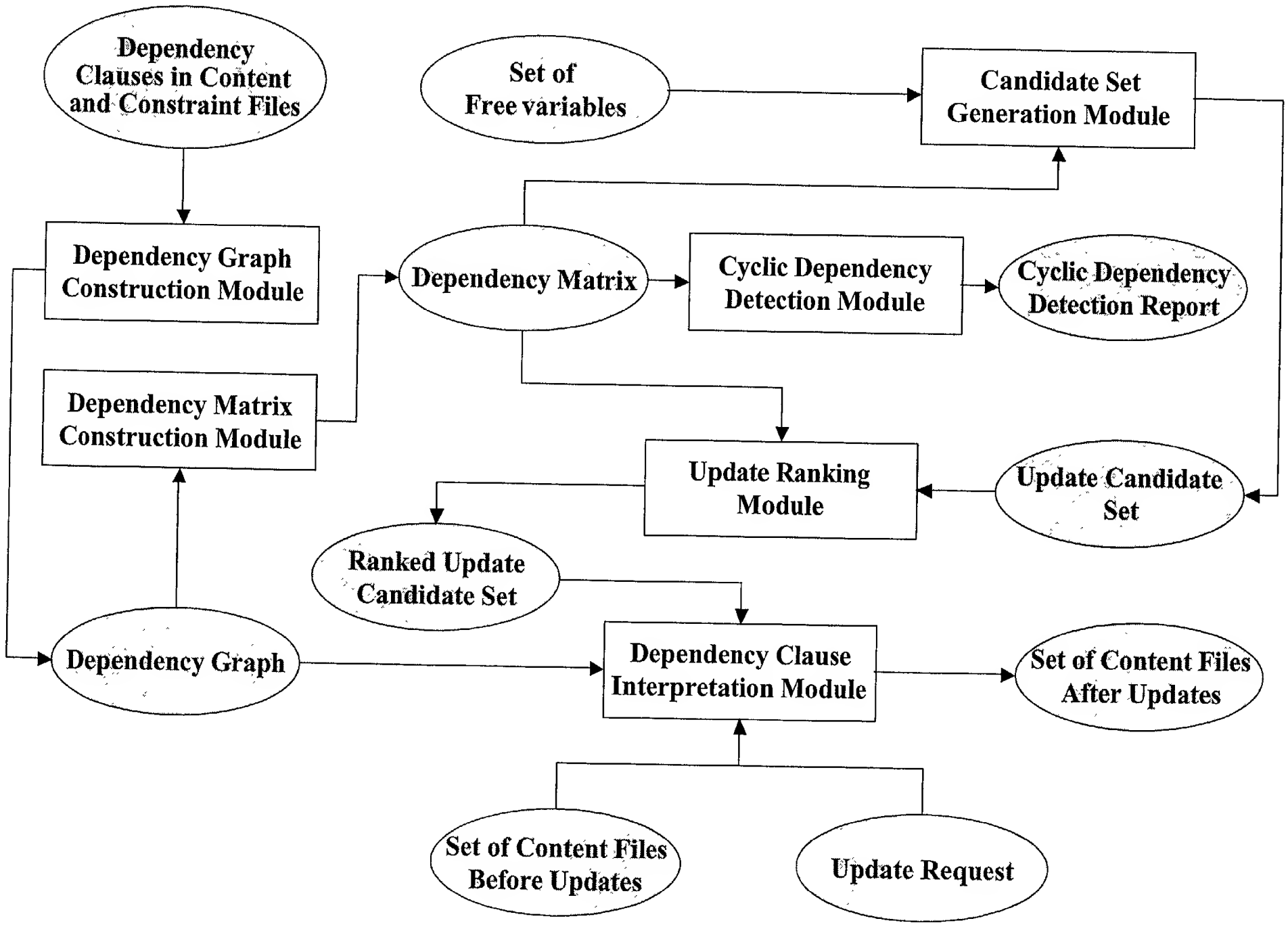
: Constraint Specification File

: Process Station

: Dependency Relationships between XML Elements

: Information Flow to and from a Station

Fig. 13


Dependency Clauses in Content and Constraint Files
Set of Free variables
Candidate Set Generation Module
Dependency Graph Construction Module
Dependency Matrix
Cyclic Dependency Detection Module
Cyclic Dependency Detection Report
Dependency Matrix Construction Module
Update Ranking Module
Update Candidate Set
Ranked Update Candidate Set
Dependency Graph
Dependency Clause Interpretation Module
Set of Content Files After Updates
Set of Content Files Before Updates
Update Request